

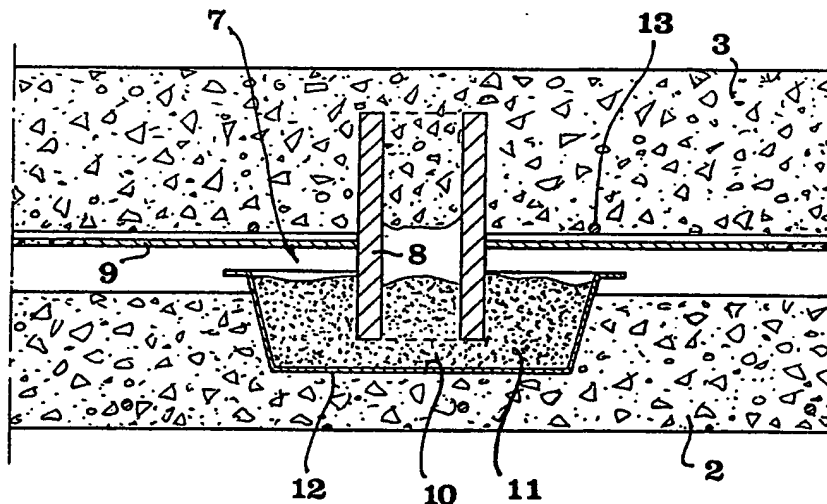


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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<b>(21) International Application Number:</b> PCT/SE93/00751 <b>(22) International Filing Date:</b> 16 September 1993 (16.09.93)  <b>(30) Priority data:</b> 9203001-4                      13 October 1992 (13.10.92)                      SE  <b>(71) Applicant (for all designated States except US):</b> FASTIGH- ETSAKTIEBOLAGET TORS HAMMARE [SE/SE]; Norrkämstaleden 8, S-827 31 Ljusdal (SE).  <b>(72) Inventors; and</b> <b>(75) Inventors/Applicants (for US only) :</b> OLOFSSON, Sting [SE/SE]; Furugatan 66, S-827 35 Ljusdal (SE). NOR- RBY, Henry [SE/SE]; Öjevägen 69, S-820 40 Järvsö (SE).  <b>(74) Agent:</b> AWAPATENT AB; P.O. Box 53, S-826 22 Söder- hamn (SE).		<b>(81) Designated States:</b> AT, AU, BB, BG, BR, BY, CA, CH, CZ, DE, DK, ES, FI, GB, HU, JP, KP, KR, KZ, LK, LU, MG, MN, MW, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SK, UA, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>With international search report.</i> <i>In English translation (filed in Swedish).</i>

**(54) Title:** BUILDING, PREFABRICATED ROOM UNIT FOR ERECTING THE BUILDING AND METHOD FOR PRODUCING AND ERECTING THE SAME

**(57) Abstract**

A prefabricated room unit for erecting buildings comprises a top panel (2), a bottom panel (3) and a plurality of wall panels. The top and bottom panels (2, 3) each have a thickness that is insufficient to prevent impermissible downward bending of the panels in the detached state of the room unit. On the underside, the bottom panel (3) is provided with a plurality of spaced-apart first connecting elements (8) adapted to cooperate with pertaining second connecting elements (10) provided on the upper side of the top panel (2) of an underlying room unit. When the room units are assembled, the connecting elements jointly form connecting means serving to prevent parallel displacement of the two comparatively thin panels (2, 3), thereby to provide a rigid floor structure not liable to bending.

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BUILDING, PREFABRICATED ROOM UNIT FOR ERECTING  
THE BUILDING, AND METHOD FOR PRODUCING AND  
ERECTING THE SAME

5 Field of the Invention

The invention generally relates to buildings of the type composed of a plurality of prefabricated room units which each comprise a top panel, a bottom panel and a plurality of wall panels, especially four, extending there-  
10 between, and which are mounted on top of one another with at least one unit mounted on top of another unit, the top and bottom panels of the individual room units each having a thickness that is insufficient to prevent impermissible downward bending of the panels in the detached state of  
15 the room unit, and the bottom panel of each overlying unit being connected to the top panel of the underlying unit by means of a plurality of spaced-apart connecting means serving to prevent parallel displacement of the panels in relation to one another, thereby to provide a rigid floor  
20 structure not liable to bending.

Such buildings are used to an increasing extent when constructing housing areas in connection with enterprises of a temporary nature, such as mines to be worked for a limited period of time or long-term building sites, e.g.  
25 in the vicinity of a nuclear or hydroelectric power station. This type of buildings is highly advantageous, in that the individual room units can be finished and even fully equipped at the factory, to be rapidly and expediently assembled on site. Furthermore, the buildings can  
30 be rapidly disassembled when the enterprise at issue has come to an end, and be reassembled elsewhere.

Description of the Prior Art

US 3,550,334 teaches a building of the type stated by way of introduction. In this building, the connecting  
35 means consist of headed, threaded bolts inserted in matching holes formed in cooperating top and bottom panels, the heads of the bolts being countersunk in seats formed in

the upper side of the bottom panel. Nuts arranged in similar seats formed in the underside of the top panel are tightened on the threads of the bolts. However, connecting means of this type require extreme precision with respect to the manufacture of the room units, the levelling of the units when being mounted, and the foundation of the building.

#### Summary of the Invention

In a first aspect, this invention aims at obviating the above inconveniences and providing a building which is erected from a plurality of easy-to-handle and easy-to-transport room units of concrete and of comparatively low total weight and which merely involves moderate precision requirements as to production and foundation. This aim is achieved by a building having the features recited in the characterising clause of independent claim 1. In a second aspect, the invention concerns a prefabricated room unit as such. The basic features of the inventive room unit are stated in the characterising clause of independent claim 2. In a third aspect, the invention relates to a method for producing and erecting buildings of the type defined in claim 1. The basic features of the inventive method are recited in the characterising clause of independent claim 4.

#### Brief Description of the Drawings

In the drawings,

- FIG. 1 is a simplified perspective view illustrating an inventive room unit on which another unit (merely schematically indicated) is about to be applied,
- FIG. 2 is a top plan view of the room unit in Fig. 1,
- FIG. 3 is a simplified, partial side view showing the area between two room units about to be interconnected,
- FIG. 4 is an enlarged section of the top and bottom panels of two room units, showing the area of a means serving to interconnect the panels,

- FIG. 5 is a perspective view of an element which forms part of the bottom panel in Fig. 4 and which, together with an element forming part of the top panel, forms the above connecting means,
- 5 FIG. 6 is an enlarged section of corner areas of two room units, the upper unit being in the process being applied on the lower unit,
- FIG. 7 is a similar section of the room units when assembled, and
- 10 FIG. 8 is a top plan view of the corner area of the lower room unit in Fig. 6.

#### Description of the Preferred Embodiment

In Fig. 1, a room unit, generally designated 1, comprises a top panel 2, a bottom panel 3 (see also Figs 3 and 4) and four wall panels which extend therebetween and which are made up of two side walls 4 and two end walls 5. In the illustrated embodiment, the room unit 1 thus basically has the shape of a parallelepiped. Door and window openings 6 and 6', respectively, are formed in one or more of the walls 4, 5. In practice, the unit 1 advantageously holds but a single room, but it is conceivable to provide the unit with one or more partitions dividing it into two or more rooms. Of course, the size as well as the positions of the openings 6, 6' may vary quite considerably. Another and similar room unit 1' is indicated above the room unit 1, on which it is to be applied.

In practice, all the panels 2, 3, 4 and 5 are made of concrete, preferably reinforced concrete. Although the wall panels 4, 5 may be comparatively thin (e.g. in the range of 50-80 mm), the top and bottom panels 2, 3 would need a thickness in the range of 150-200 mm to obtain sufficient strength and rigidity to be able to separately carry load without exhibiting any tendencies to bending downwards. Naturally, if the two panels 2, 3 were that thick, the total weight of the room unit would become quite considerable.

In order to avoid such an inconvenience, the top and bottom panels 2, 3 of the room unit (see Fig. 4) each should have a thickness in the range of 40-100 mm, suitably 50-80 mm. However, a thickness in that range is in itself insufficient to ensure that the loaded panels are not unduly bent downwards when the room unit is in the detached state. Thus, to ensure that the two panels 2, 3 jointly form a rigid floor structure not liable to bending when assembled, the panels are interconnected by means of a plurality of spaced-apart connecting means, of which one, generally designated 7, is shown in Fig. 4. In the preferred embodiment illustrated, the connecting means 7 comprises a first connecting element 8 consisting of a male element or projection from the underside of the bottom panel 3, the projection being in the form of a tube embedded in the panel 3. As can be seen in Fig. 5, the tube 8 is fixed to a thin metal sheet 9 flush with or close to the underside of the panel 3. An upwardly open seat 10 for accommodating casting material 11 in which the tube 8 can be embedded, is formed in the upper side of the top panel 2. In the embodiment illustrated, a bowl 12, which has a frustoconical, upwardly diverging shape and which separates the casting material 11 from the concrete in the panel 2, is arranged in the seat 10. In practice, the bowl 12 is advantageously made of plastic and serves to facilitate the separation of the panels 2, 3 in the event of the room units being disassembled. Fig. 4 further shows a reinforcement 13 which in practice is arranged in both panels 2, 3. Although this reinforcement may consist of conventional wire netting, it may alternatively be a fibre glass reinforcement which can be arranged at close proximity to the underside of the concrete panel, thereby minimising the thickness of the panel. In the embodiment shown in Fig. 4, the top panel 2 has a thickness of 60 mm and the bottom panel 3 has a thickness of about 80 mm.

In Fig. 1, nine seats with associated bowls 12 are formed in the upper side of the top panel 2. To be more precise, the seats are arranged in three rows of three seats each, the central row being situated approximately halfway between the two end walls of the room unit, and the other two rows being situated in the vicinity of the end walls, albeit at a considerable distance therefrom. The tubes 8 projecting from the underside of the bottom panel 3 are arranged in an analogous pattern. Cups 14, whose function will be described in more detail with reference to Figs 6-8, are provided on the top panel 2 at the corners of the room unit 4. Moreover, three spacers 15 are placed on the top panel 2 and serve to position the overlying room unit 1' in the correctly levelled horizontal position when lowered onto the underlying unit 1. Each spacer 15 may consist of one or more metal washers or plates built up to the right level after levelling has been performed with the aid of a conventional levelling instrument.

Figs 6 and 7 illustrate a corner area of two room units, one unit being about to be lowered onto the other. In practice, the cup 14 may advantageously be a circular plastic cup, a number of slits 16 being formed in the circumferential wall of the cup to facilitate deformation thereof. When the units are to be assembled, the cup is applied on the top panel of the underlying room unit and is advantageously fixed in the desired position by means of a pin 17, or the like. Then, the cup is filled with casting material 18, such as concrete or mortar, in full measure. More precisely, the height of the casting material 18 should exceed that of the highest spacer 15.

#### Assembly

When a prefabricated room unit 1' from the factory is to be mounted on an existing underlying room unit 1, one proceeds as follows. First, the spacers 15 are levelled, such that the upper sides of all three are situated in a common horizontal plane. Then, the bowls 12 and the cups

14 are filled with casting material, advantageously conventional mortar or concrete, at least the cups 14 being filled in full measure, as shown in Fig. 6. Subsequently, the room unit 1' is lowered onto the underlying unit 1 until the underside of its bottom panel 3 is applied against the upper side of the spacers 15. At the end of this downward movement, the projections or tubes 8 penetrate into the casting material 11 in the bowls 12, while at the same time casting material 18 in the four cups 14 is pressed out laterally to form a supporting plate whose height is perfectly adapted to the height of the gap between the panels 2, 3, which is determined by the spacers 15. This takes place automatically, owing to the cup walls allowing unresisting deformation and the upper room unit being more than heavy enough to press out the casting material 18. When the casting material 18 has set after a certain period of time, it forms a supporting plate taking up any vertical loads from the overlying room unit 1'. Once the casting material 11 in the bowls 12 has set, the cast body forms, together with the tube 8, a connecting means taking up any shearing or transverse forces between the two panels 2, 3, thus preventing or counteracting parallel displacement of the panels. As a result, the two panels 2, 3 will cooperate to form a resistant, flexurally rigid floor structure, despite the comparative thinness of the panels. When mounted, the panels 2, 3 will therefore form a strong floor structure able to carry a considerable load without causing e.g. cracks to form in any covering on the underside of the top panel 2.

#### Disassembly

If the building composed of the illustrated room units is to be disassembled and moved after some time, this is easily performed by simply lifting up each overlying room unit from the unit below. The cast body will then be pulled up from its position in the seat 10 without any substantial resistance owing to the provision of the



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bowl 12 delimiting the cast body 11 from the concrete in the panel 2. The cast body 18 at the corners of the room units exert even less resistance to such a lifting operation.

5        Although the foregoing description of the invention is based on the fact that it should be possible to easily and expediently disassemble the building, the invention is primarily intended for erecting permanent buildings meeting high requirements on amenities for a consider-  
10    able period of time. The possibility of disassembling the buildings should be regarded as a secondary, albeit advantageous, alternative.

#### Conceivable Modifications of the Invention

      It goes without saying that the invention is by no  
15    means restricted to the embodiment described above and shown in the drawings. Thus, the reinforced concrete in the top and bottom panels of the room units can be replaced with other equivalent materials, preferably casting materials. It should here also be pointed out that mate-  
20    rial other than concrete can be used for the wall panels 4, 5. Thus, the wall material may differ radically from the material used in the top and bottom panels.

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## CLAIMS

1. A building composed of a plurality of prefabricated room units (1, 1') which each comprise a top panel (2), a bottom panel (3) and a plurality of wall panels (4, 5), especially four, extending therebetween, and which are mounted on top of one another with at least one unit (1') mounted on top of another unit (1), the top and bottom panels (2, 3) of the individual room units each having a thickness that is insufficient to prevent impermissible downward bending of the panels in the detached state of the room unit, and the bottom panel (3) of each overlying unit being connected to the top panel (2) of the underlying unit by means of a plurality of spaced-apart connecting means (7) serving to prevent parallel displacement of the panels (2, 3) in relation to one another, thereby to provide a rigid floor structure not liable to bending, characterised in that the connecting means (7) include first connecting elements in the form of projections (8) from the underside of the bottom panel (3), as well as second connecting elements in the form of upwardly open seats (10) formed in the upper side of the top panel and containing casting material (11) in which the pertaining projections (8) are embedded.

2. A prefabricated room unit for erecting buildings, comprising a top panel (2), a bottom panel (3) and a plurality of wall panels (4, 5), especially four, extending therebetween, the top and bottom panels (2, 3) each having a thickness that is insufficient to prevent impermissible downward bending of the panels in the detached state of the room unit, the bottom panel (3) being provided on the underside with a plurality of spaced-apart first connecting elements (8) adapted to cooperate with pertaining second connecting elements (10) provided on the upper side of the top panel (2) of an underlying room unit in a building, the top panel (2) being provided on the upper

side with a plurality of spaced-apart second connecting elements (10) adapted to cooperate with pertaining first connecting elements (8) provided on the underside of the bottom panel (3) of an overlying room unit, and said connecting elements (8, 10) jointly forming, in the assembled state of the room units, connecting means (7) serving to prevent parallel displacement of two adjoining top and bottom panels (2, 3) in a building, thereby to provide a rigid floor structure not liable to bending, c h a r -  
a c t e r i s e d in that the first connecting elements consist of projections (8) from the underside of the bottom panel (3), and that the second connecting elements consist of upwardly open seats (10) formed in the upper side of the top panel for receiving casting material (11) in which the projections (8) can be embedded.

3. A room unit as claimed in claim 2, c h a r a c - t e r i s e d in that a conical, upwardly diverging bowl (12), e.g. of plastic, is arranged in the seat (10) and serves to accommodate and delimit the casting material (11) when mounting the room unit in a building, as well as to facilitate the separation of cooperating top and bottom panels in the event of dismounting of the room unit.

4. A method for producing and erecting buildings assembled on site from a plurality of prefabricated room units (1, 1') which each comprise a top panel (2), a bottom panel (3) and a plurality of wall panels (4, 5), especially four, extending therebetween, the top and bottom panels (2, 3) of each room unit being manufactured with a thickness that is insufficient to prevent impermissible downward bending of each panel, the room units being supplied in this state from the factory to the building site, and the bottom panel (3) of each overlying unit (1') being connected, when assembling the room units on site with at least one unit (1') mounted on top of another unit (1), to the top panel (2) of the underlying unit (1) by means of a plurality of spaced-apart connecting means (7) serving to prevent or counteract relative parallel dis-

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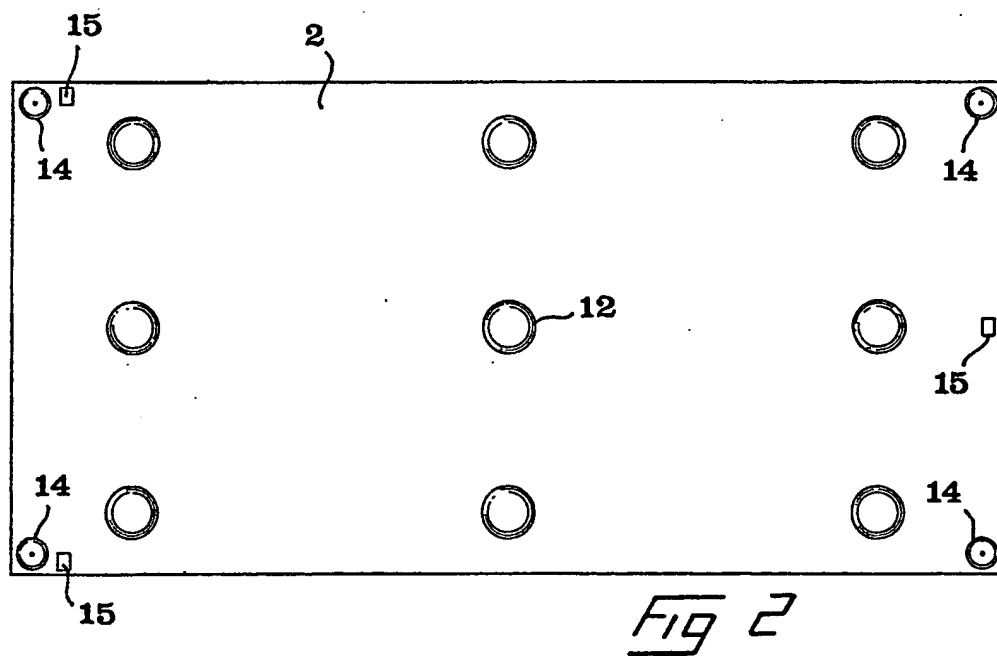
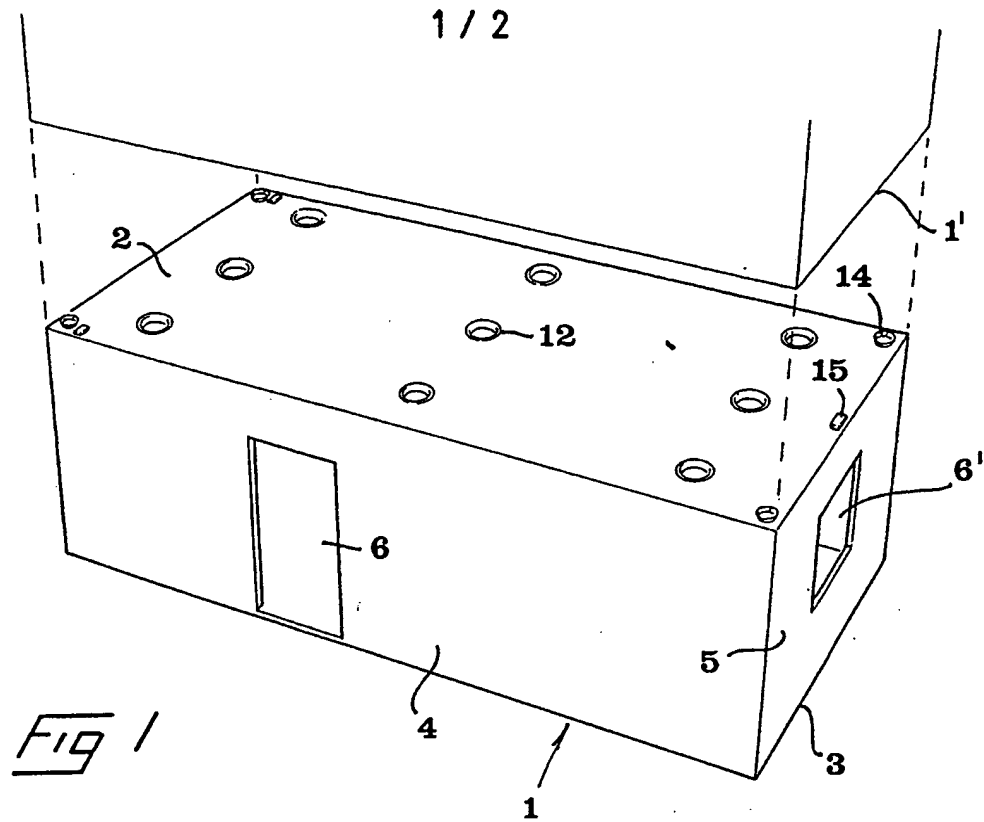
placement of the panels, thereby to cause the panels, when in the mounted state, to jointly form a rigid floor structure not liable to bending, characterised in that the connecting means (7) consist of projections (8) from the underside of the bottom panel (3) and upwardly open seats (10) which are formed in the upper side of the top panel (2) and in which is applied casting material (11) caused to set while fixing the projections (8).

5 5. A method as claimed in claim 4, characterised in that, when mounting a room unit (1') on top of another unit (1), the upper room unit (1') is correctly levelled by means of a number of spacers (15), e.g. three, which are arranged on top of the top panel (2) of the underlying unit together with at least four definitively bearing or load-absorbing means, suitably provided at the corners and each produced by means of casting material (18) which is applied in a cup (14) and whose height initially exceeds that of the highest spacer (15) and which, when the overlying room unit (1') is lowered onto  
10 15 20 the spacers on top of the underlying room unit, is deformed and adapted to the height determined by the spacers before setting.

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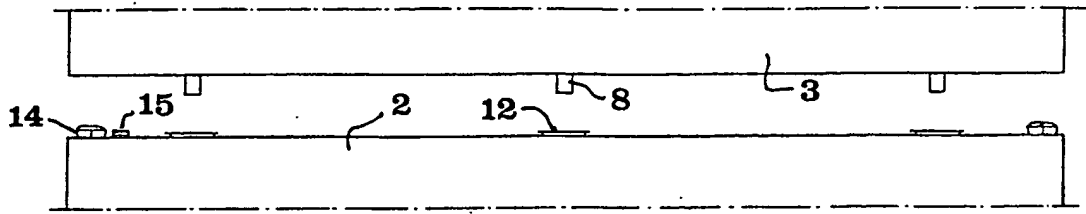


Fig 3

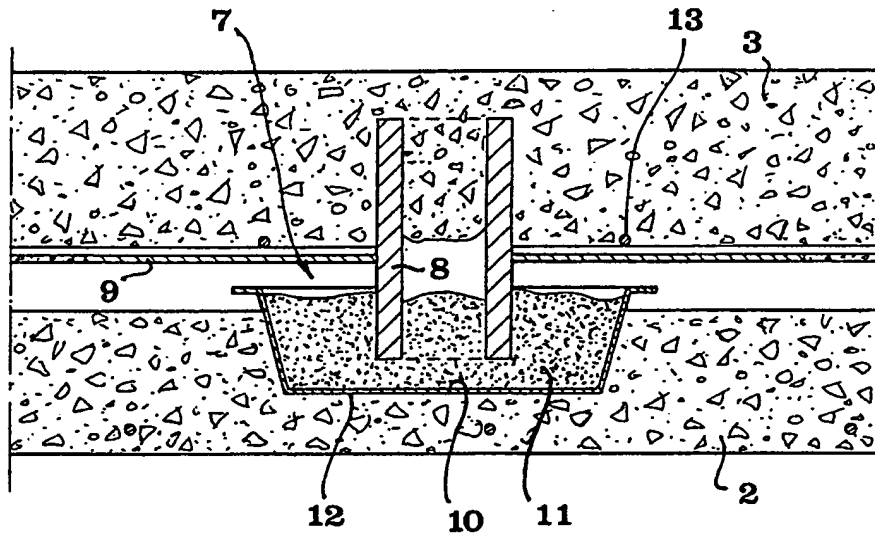


Fig 4

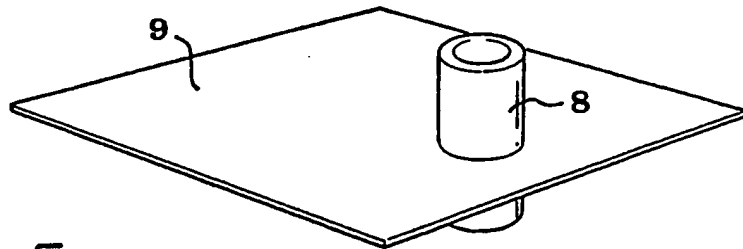


Fig 5

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INTERNATIONAL SEARCH REPORT

International application No.  
PCT/SE 93/00751

<b>A. CLASSIFICATION OF SUBJECT MATTER</b>		
IPC5: E04B 1/348, E04B 1/343 According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b>		
Minimum documentation searched (classification system followed by classification symbols)		
IPC5: E04B		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
SE,DK,FI,NO classes as above		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 3550334 (C. VAN DER LELY), 29 December 1970 (29.12.70), column 4, line 54 - line 57; column 4, line 65 - line 68, figures 5,6  --	1-5
A	US, A, 4019293 (E.S. ARMAS), 26 April 1977 (26.04.77), column 3, line 6 - line 28, figures 1, 5,6  --	1-5
A	US, A, 4159602 (A.M. POLACK), 3 July 1979 (03.07.79), column 3, line 36 - line 45, figures 9-11  --	1-5
<div style="display: flex; justify-content: space-between;"> <span><input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C.</span> <span><input checked="" type="checkbox"/> See patent family annex.</span> </div>		
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>* Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&amp;" document member of the same patent family</p> </div> </div>		
Date of the actual completion of the international search		Date of mailing of the international search report
8 December 1993		13-12-1993
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86		Authorized officer  Ingemar Hedlund Telephone No. +46 8 782 25 00

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 93/00751

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	DE, A1, 2435882 (LITTLE, P.A.), 6 February 1975 (06.02.75), page 3, 2nd paragraph, page 4 last paragraph - page 5, line 2, figures 5,6 --	1-5
A	DE, A1, 2408843 (GALVAGNI, M. ET AL), 4 Sept 1975 (04.09.75), page 4, last paragraph - page 5, line 2, figure 1 -- -----	1-5



# INTERNATIONAL SEARCH REPORT

Information on patent family members

16/10/93

International application No.

PCT/SE 93/00751

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